MULTIMEDIA UNIVERSITY®

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

EMT1016 ENGINEERING MATHEMATICS I

(All Sections / Groups)

29 FEB 2016
2:30 P.M – 4:30 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 4 pages including this cover page with 4 questions only.

2. Attempt all four questions. All questions carry equal marks and the distribution of marks for each question is given.

3. Print all answers in the answer booklet provided. Do show all relevant steps.

4. Programmable calculator is not allowed.

Question 1

(a) Evaluate the following limits:

(i) $\lim_{x\to -\infty} \dfrac{\sqrt{x^2-11}}{2x+10}$ [4 marks]

(ii) $\lim_{x\to 0^-} \dfrac{\ln(2x)}{x}$ [3 marks]

(b) If $x^3 + xy^2 + \sqrt{y} + e^{x^2} = 3$, use implicit differentiation to find $\dfrac{dy}{dx}$.

[5 marks]

(c) Decompose $f(x) = \dfrac{2x-11}{x^2-x-6}$ into partial fractions. Hence, evaluate $\int f(x)\,dx$.

[6 marks]

(d) A region R is bounded by the curves $y = -x^2 + 6$ and $y = |x|$. Sketch R and calculate its area.

[7 marks]

Question 2

(a) Let $f(x,y) = \dfrac{x^2 - y^3}{x^2 + 3y^2}$, $(x,y) \neq (0,0)$.

(i) Find $\lim_{(x,y)\to(0,0)} f(x,y)$ along the line $y = 0$. [2 marks]

(ii) Find $\lim_{(x,y)\to(0,0)} f(x,y)$ along the line $x = 0$. [2 marks]

(iii) What can you conclude about the limit of $f(x,y)$ as $(x,y) \to (0,0)$? [2 marks]

(b) Let $z = \ln(2x + y^3)$ where $x = -4t^2$ and $y = 5t^5$. Find $\dfrac{dz}{dt}$ in terms of t only.

[6 marks]

(c) Use the method of Lagrange multipliers to find the maximum and minimum values of the function

$$f(x,y) = xy,$$

subject to the constraint $x^2 + \dfrac{y^2}{6} = 36$.

[13 marks]

Continued ...

Question 3

(a) Given $Z_0 = 50$ and $Z_L = 100 + i100$, evaluate $\Gamma = \dfrac{Z_L - Z_0}{Z_L + Z_0}$.

[4 marks]

(b) Find all the roots of $w^3 = 1 - i4$.

[7 marks]

(c) Given vectors $\mathbf{a} = \langle 1,2,3 \rangle$, $\mathbf{b} = \langle 2,-1,0 \rangle$ and $\mathbf{c} = \langle -1,3,3 \rangle$,

(i) show that $\mathbf{a}$ and $\mathbf{b}$ are perpendicular,

[3 marks]

(ii) show that $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$ lie on the same plane,

[4 marks]

(iii) determine the unit vectors $\hat{\mathbf{a}}$ and $\hat{\mathbf{b}}$, and

[3 marks]

(iv) resolve $\mathbf{c}$ into two perpendicular components along $\hat{\mathbf{a}}$ and $\hat{\mathbf{b}}$.

[4 marks]

Continued ...

Question 4

(a) Test the series $\sum_{n=0}^{\infty} \frac{1}{2^n - 1}$ for convergence or divergence.

[4 marks]

(b) Given $\frac{1}{1-x} = \sum_{n=0}^{\infty} x^n, -1 < x < 1$, find the Maclaurin series of $f(x) = \frac{3}{x-2}$ and its interval of convergence (omit convergence test at boundary points).

[5 marks]

(c) Write down the set of equations defining the periodic function shown in Fig. Q4.

[3 marks]

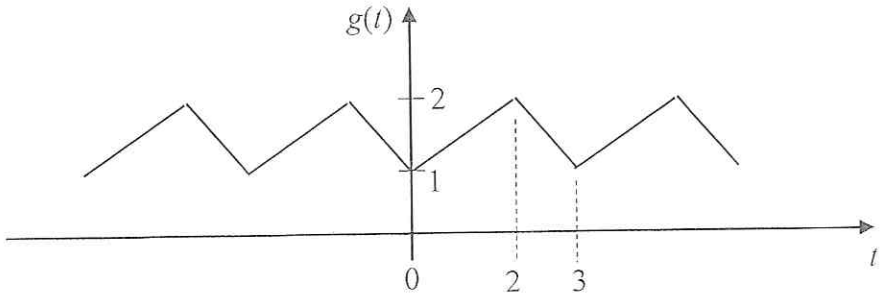

Fig. Q4

(d) Find the trigonometric Fourier series of the following periodic function.

$$f(x) = 2x - 1, \quad -2 < x < 2$$
$$f(x) = f(x+4), \quad -\infty < x < \infty$$

[13 marks]

End of Paper